Technical Note

# Combined Anterior Cruciate Ligament and Lateral Collateral Ligament Reconstruction

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**Abstract:** Lateral collateral ligament (LCL) injuries are commonly associated with other knee ligament injuries such as anterior cruciate ligament (ACL) injuries. Significant injuries to the LCL should be addressed at the same time as ACL reconstruction. This prevents any varus instability, which can jeopardize the integrity of the ACL graft, resulting in graft failure. This technical note describes combined ACL and LCL reconstruction using an outside-in drilling technique for the femoral tunnel in which the hamstring tendons are used for simultaneous reconstruction of both injured ligaments, which avoids tunnel convergence.

The lateral collateral ligament (LCL) is an important stabilizer of the lateral side of the knee; it acts as the primary restraint to varus forces at all knee flexion angles and resists external rotation near extension.[1] Injuries to the LCL occur as a result of direct varus stress or twisting of the knee. They are commonly associated with other knee ligament injuries, such as anterior cruciate ligament (ACL) injuries, posterior cruciate ligament injuries, injuries of the posterolateral corner (PLC) structures, and multiligament knee injuries.[2]

If left untreated, significant LCL injuries may lead to chronic instability and secondary damage of the meniscus or articular cartilage, resulting in the early development of osteoarthritis.[3] Moreover, the combination of an untreated LCL injury and concomitant ACL reconstruction (ACLR) could jeopardize the integrity and survivorship of the ACL graft by increasing forces on the graft.[4] Numerous surgical techniques for LCL reconstruction are described in the literature, including techniques using semitendinosus autograft,[5,6] bone–patellar tendon–bone autograft,[7] and quadriceps tendon–bone autograft.[8]

The purpose of this technical note is to describe a safe, easy, and reproducible technique for combined ACL and LCL reconstruction using hamstring tendons (Video 1). This technique uses the tunnel created by outside-in drilling for ACLR, without an additional femoral tunnel, which avoids potential convergence when using separate tunnels.

## Surgical Technique

This technical note describes our technique for combined ACL and LCL reconstruction in a single-stage procedure using hamstring tendons (Video 1). Pearls and pitfalls of this procedure are described in Table 1, and advantages and disadvantages are presented in Table 2.

### Patient Positioning

The patient is placed in the supine position on the operating table with a lateral support at the level of a padded tourniquet and a foot roll positioned to maintain 90° of knee flexion. The injured leg is prepared and draped with the surgeon's preferred method, similar to any arthroscopic procedure around the knee. The appropriate landmarks are palpated and marked,

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**Table 1.** Pearls and Pitfalls

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| Pearls |
| Beginners should perform a large incision at the femoral epicondyle to ensure the correct placement of the guidewire proximal and posterior to the LE (anatomic femoral insertion of LCL). |
| The surgeon should be aware of the correct trajectory of the LCL graft below the ITB. |
| Careful dissection of the common peroneal nerve at the neck of the fibula is required. |
| Pitfalls |
| Iatrogenic injury to the common peroneal nerve during dissection or tunnel drilling at the FH is possible. |
| If the harvested hamstring tendons are of insufficient length, it may be difficult to proceed with LCL reconstruction using the same graft. |

FH, fibular head; ITB, iliotibial band; LCL, lateral collateral ligament; LE, lateral epicondyle.

including the joint line, head of the fibula, and lateral epicondyle.

## Graft Harvest and Diagnostic Arthroscopy

The semitendinosus and gracilis tendons are harvested with an open-ended tendon stripper using the surgeon's preferred method. The free end of the gracilis tendon is whipstitched using a No. 0 suture (Mersilene; Ethicon, Somerville, NJ). The tibial insertion is preserved to improve fixation and vascularity.[9] The tendons are then wrapped in vancomycin-soaked swabs to reduce the risk of septic arthritis.[10]

High anterolateral and anteromedial portals are then established. A diagnostic arthroscopy is performed, and any meniscal or cartilage lesions are addressed prior to ACLR and LCL reconstruction.

## Preparation for LCL Reconstruction

Two skin incisions are made initially: first, at the level of the lateral epicondyle, and second, just anterior to the fibular head (FH). The subcutaneous tissues are dissected posteriorly to expose the FH and the biceps femoris tendon. The common peroneal nerve is identified at the neck of the fibula. Metzenbaum scissors are then inserted subaponeurotically, posteriorly, and parallel to the biceps femoris tendon, superficially to the nerve. An incision is made opposite the scissors' blades to free the common peroneal nerve. The distal attachment of the LCL is then dissected with an incision on either side to facilitate the upcoming tunnel in the FH. With the use of a guide, a guidewire is introduced and a tunnel is created with a 6-mm reamer while the common peroneal nerve is protected with a simple retractor. A suture loop is then passed through the tunnel using a No. 2 suture (Mersilene), which is used to facilitate LCL graft passage later in the procedure (Fig 1).

**Table 2.** Advantages and Disadvantages

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| Advantages |
| The technique uses a single HT graft, without the need for additional graft harvest preparation. |
| The technique uses a single femoral tunnel via an outside-in technique, achieving anatomic positioning of the ACL and LCL. |
| Disadvantages |
| Malpositioning of the femoral tunnel may lead to either tightening or loosening of the LCL, depending on the direction and the extent of the misplacement. |
| The surgeon must be familiar with the outside-in technique for ACL reconstruction. |

ACL, anterior cruciate ligament; HT, hamstring tendon; LCL, lateral collateral ligament.

## Creation of Femoral and Tibial Tunnels

The femoral outside-in ACL guide (Arthrex, Naples, FL) is inserted into the knee via the anteromedial portal. It is placed at the femoral origin of the ACL in a mid-anteromedial bundle position. The bullet is placed proximal and posterior to the lateral epicondyle to reproduce the anatomic femoral insertion of the LCL for the next step of the procedure. A guidewire is introduced, followed by a 6-mm reamer, to allow any adjustments when the appropriately sized reamer (based on graft size) is used. A shaver is then inserted to remove any graft remnant or debris from reaming (Fig 2).

The tibial ACL guide (Arthrex) is set at 65° to be placed just above the hamstring insertion and is then introduced into the knee via the anteromedial portal. It is positioned over the ACL footprint, and a guidewire is inserted. A 6-mm reamer is initially used to allow any adjustments with the appropriately sized reamer based on graft size. A shaver is then inserted to remove any graft remnant or suture material (Fig 2).

## Graft Preparation

A No. 2 passing suture (Polysorb; Covidien, Mansfield, MA) is delivered from the femoral tunnel through the tibial tunnel. Tunnel length is measured. The gracilis is detached from its tibial insertion and sutured to the semitendinosus with a No. 0 suture (Mersilene). A No. 2 suture (Mersilene) is then positioned at the distal mark, and the semitendinosus is folded back onto itself and sutured with a further No. 0 suture. Finally, the semitendinosus is tripled, and several No. 0 sutures are used to tubularize the graft. As a result, an ACL graft that is 3 parts semitendinosus and 1 part gracilis is created, with the additional continuation of the gracilis for the LCL graft (Fig 3).

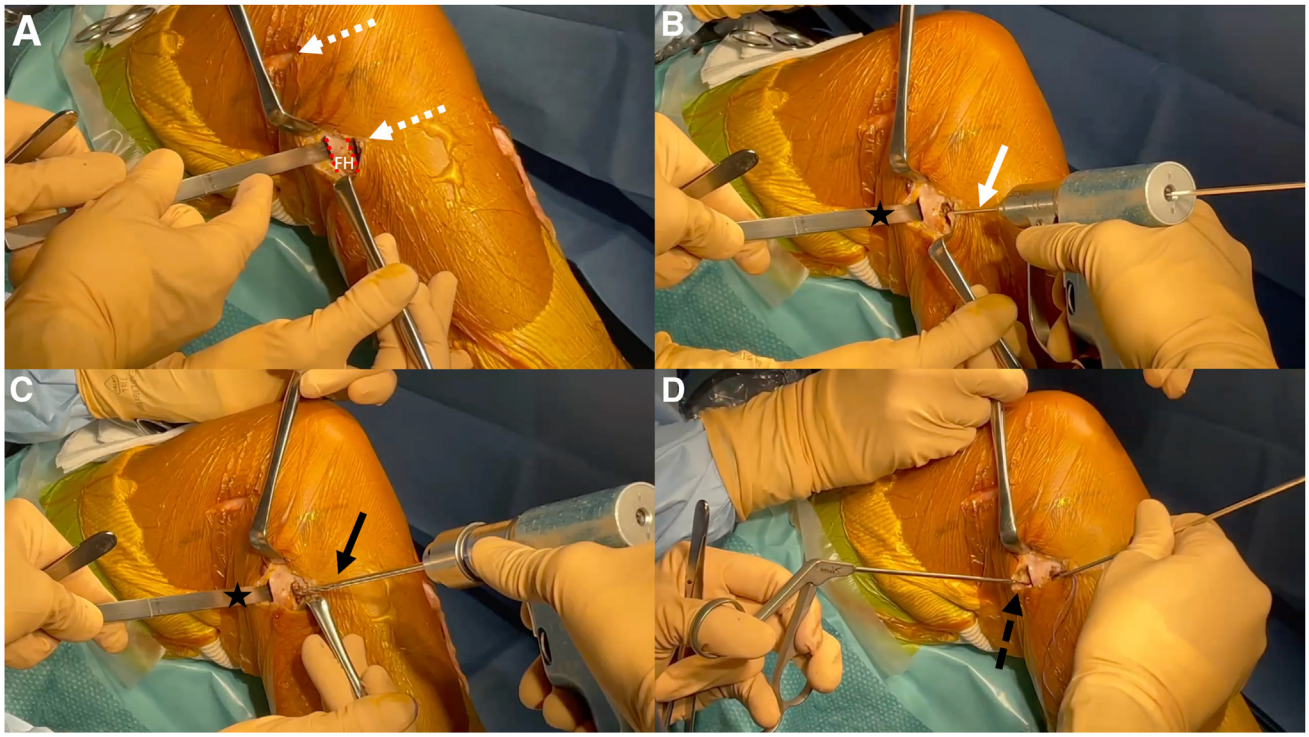


**Fig 1.** Preparation for lateral collateral ligament reconstruction in right knee: anterolateral view. (A) Two skin incisions (white arrows) are made: one at the level of the lateral epicondyle and the other just anterior to the fibular head (FH). An incision is made on either side of the distal attachment of the lateral collateral ligament (red dotted line). (B, C) A guidewire (white arrow) is introduced and a tunnel is created with a 6-mm reamer (black arrow) while the common peroneal nerve is protected with a simple retractor (black stars). (D) A suture loop (black arrow) is passed through the tunnel.

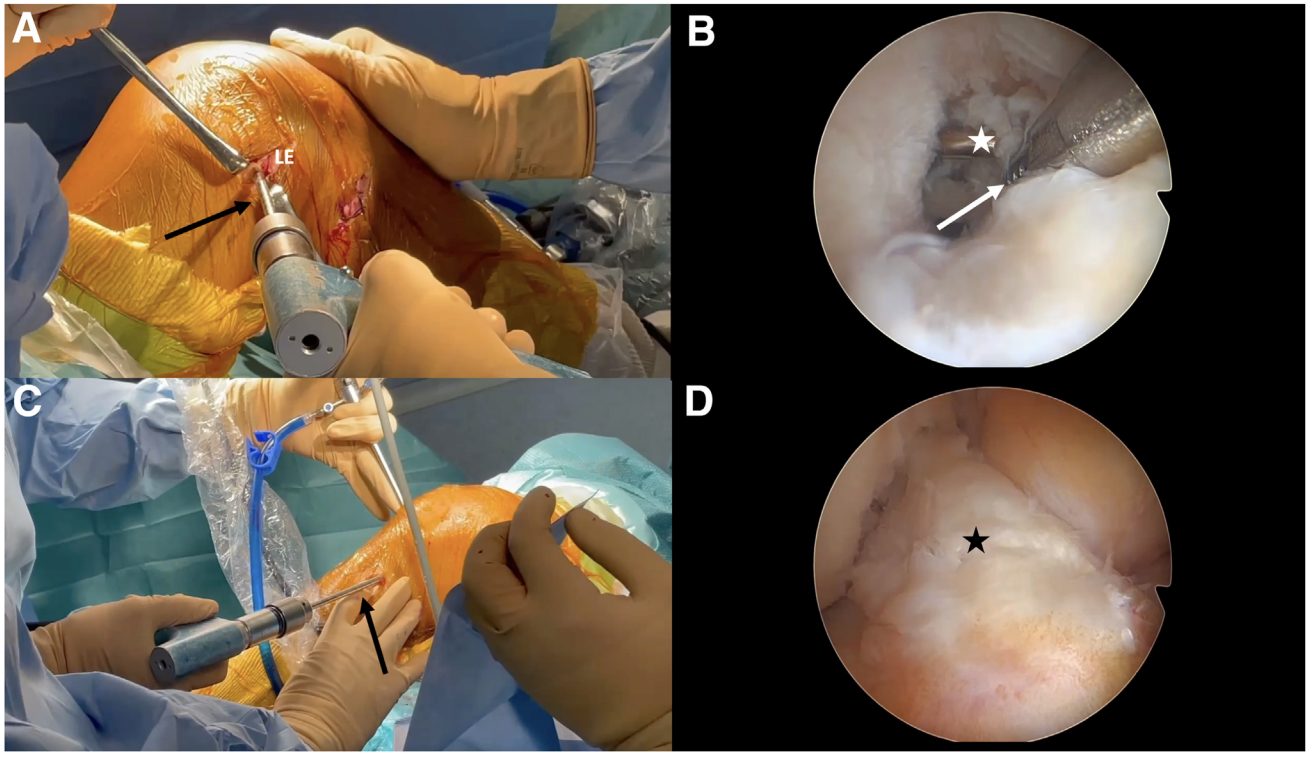


**Fig 2.** Anterior cruciate ligament tunnels in right knee. (A) Lateral view. The femoral tunnel is created using an outside-in drilling technique (black arrow) proximal and posterior to the lateral epicondyle (LE). (B) Arthroscopic view. A reamer (white star) (based on graft size) is inserted into the knee, and a shaver (white arrow) is used to remove any debris. (C). Anteromedial view. The tibial tunnel is created using the appropriately sized reamer (black arrow). (D) As much anterior cruciate ligament remnant (black star) as possible is retained with careful reaming.

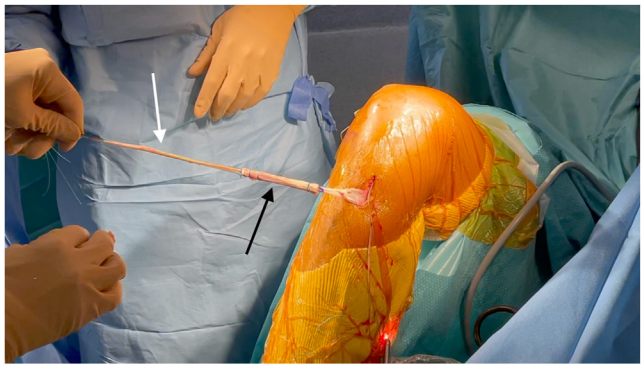

**Fig 3.** Graft preparation in right knee: frontal view. An anterior cruciate ligament graft that is 3 parts semitendinosus and 1 part gracilis (black arrow), with an additional continuation of the gracilis (white arrow) for the lateral collateral ligament graft, is prepared.

## ACL Graft Passage and Fixation

The graft is shuttled from the tibial tunnel through the femoral tunnel using the passing suture. A nitinol guidewire is inserted into the tibial tunnel; then, with tension applied to the graft where it exits the femoral tunnel, an interference screw (Biocomposite; Arthrex) is inserted into the tibial tunnel. Next, a nitinol guidewire is inserted into the femoral tunnel and an interference screw is inserted with the knee at 30° of flexion while tension is applied to the graft.[11] The ACL graft is now fixed while the remaining gracilis lies free.

## LCL Graft Passage and Fixation

A suture grasper is used to deliver the whipstitched gracilis under the iliotibial band (ITB) to the posterior aspect of the FH. The previously prepared suture loop then allows passage of the graft to the anterior aspect. The suture grasper is reinserted under the ITB and delivers the graft back to the femoral incision. The suture ends of the LCL graft are tied in 20° of flexion, slight valgus, and neutral rotation[12] (Figs 4 and 5).

## Additional PLC Reconstruction and Modified Lemaire Procedure

LCL tears are rarely found in isolation and are often combined with PLC injuries. This combined ACL and

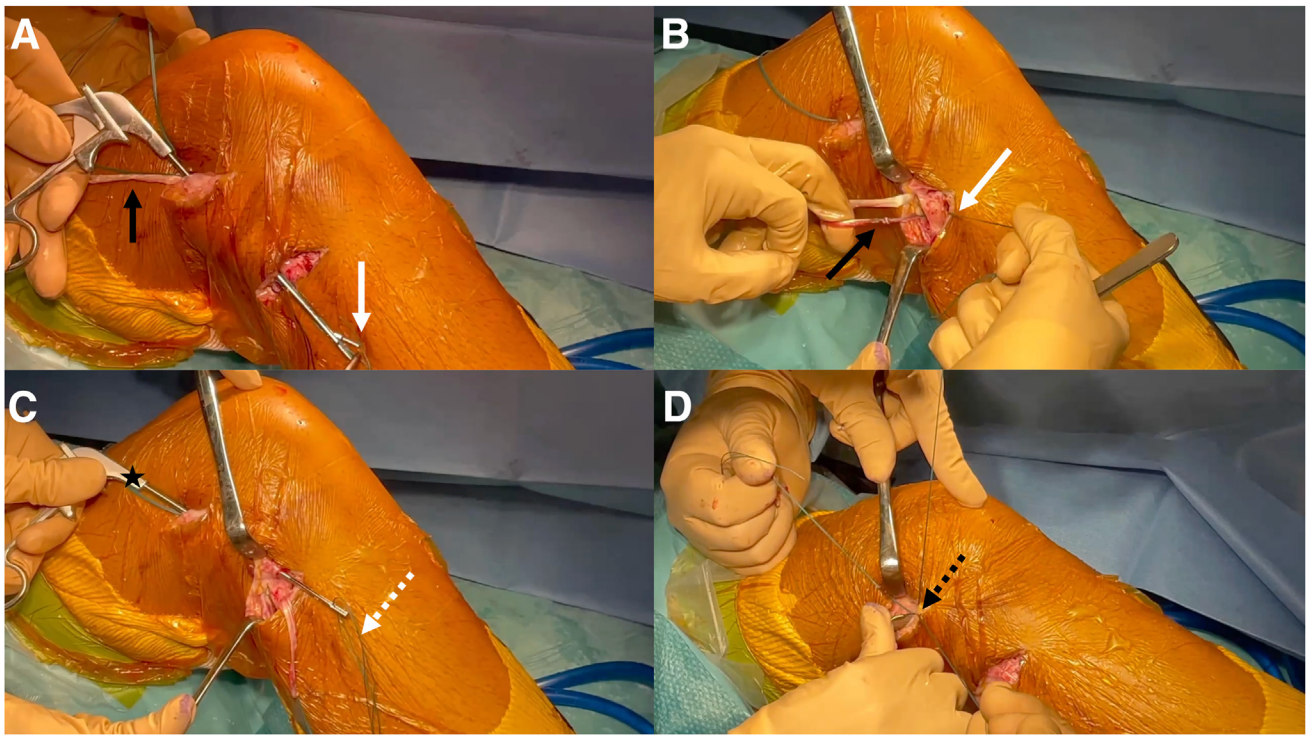


**Fig 4.** Lateral collateral ligament graft passage and fixation in left knee: lateral view. (A, B) A suture grasper passes under the iliotibial band to retrieve the guide suture (white arrows), facilitating the passage of the gracilis tendon (black arrows) to the posterior aspect of the fibular head. (C) The suture grasper (black star) pulls back the suture with the gracilis tendon (white arrow). (D) The suture ends of the lateral collateral ligament graft (black arrow) are tied with the knee in 20° of flexion, slight valgus, and neutral rotation.

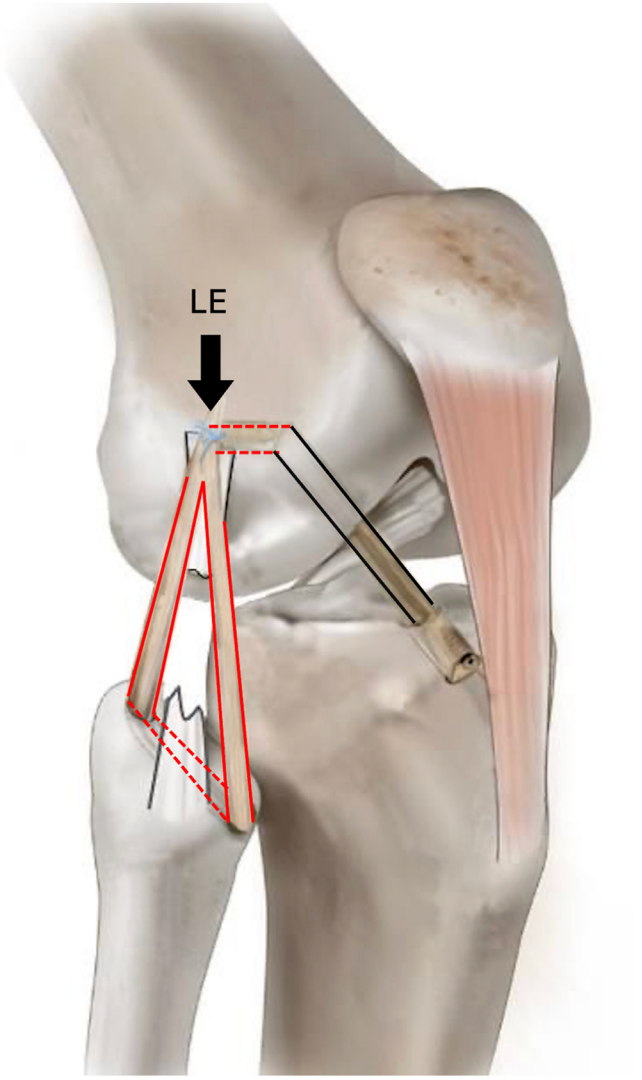


**Fig 5.** Final aspect of combined anterior cruciate ligament and lateral collateral ligament reconstruction with continuous graft. The lateral collateral ligament graft is represented by solid red lines, with its tunnel indicated by dotted red lines. The anterior cruciate ligament graft is represented by black lines. (LE, lateral epicondyle.)

LCL reconstruction technique can be combined with reconstruction of the popliteus and the modified Lemaire procedure.

Figure 6 shows a standard exposure for the modified Lemaire procedure in a patient. An allograft is used in this case for reconstruction of the popliteus, limiting the number of autografts required. A 1-cm-wide strip of the ITB is harvested in a standard fashion for the modified Lemaire procedure. Both grafts are fixed to the femur using 4.75-mm Biocomposite SwiveLock devices (Arthrex) to limit the risk of crossing the femoral tunnels (Fig 6).

### Postoperative Rehabilitation

Postoperative rehabilitation consists of brace-free, immediate full weight bearing and progressive range-of-motion exercises, with restriction of range of motion to 0° to 90° for 6 weeks if meniscal repair is performed. Early rehabilitation focuses on maintaining full extension and quadriceps activation exercises. Return to sports is allowed at 4 months for non-pivoting sports, at 6 months for pivoting non-contact sports, and at 8 to 9 months for pivoting contact sports.

## Discussion

An isolated LCL injury of the knee is rare, and LCL injuries are commonly associated with ACL, posterior cruciate ligament, and/or PLC injuries. An untreated grade III LCL lesion can lead to chronic varus instability, resulting in damage to the medial compartment of the knee. LCL injury should be addressed at the same time as concomitant ACLR because, if left untreated, abnormal load sharing with the ACL graft increases the risk of failure.

Historically, reconstruction of the LCL of the knee with concomitant ACLR was performed in different steps during the same procedure using different femoral tunnels and autografts.[5,6] As a result, convergence between the femoral tunnels of the LCL and ACL could occur. Furthermore, a double graft harvest or the use of allograft was needed to reconstruct both the ACL and LCL.

In conclusion, combined ACL and LCL reconstruction using an outside-in drilling technique with hamstring autograft is a safe and reliable technique and avoids not only the need for a second graft (autograft or allograft) but also any potential convergence between the femoral tunnels of the ACL and LCL reconstruction.

## Disclosures

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: A.C. receives funding grants from Arthrex. B.S-C. reports a consulting or advisory relationship with Arthrex; receives funding grants from Arthrex; owns equity or stocks in AREAS; and reports board membership with Société Francophone d'Arthroscopie. All other authors (G.P.H., S.G., L.G., E.R., C.P., A.E.H., T.D.V., H.F.P.) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

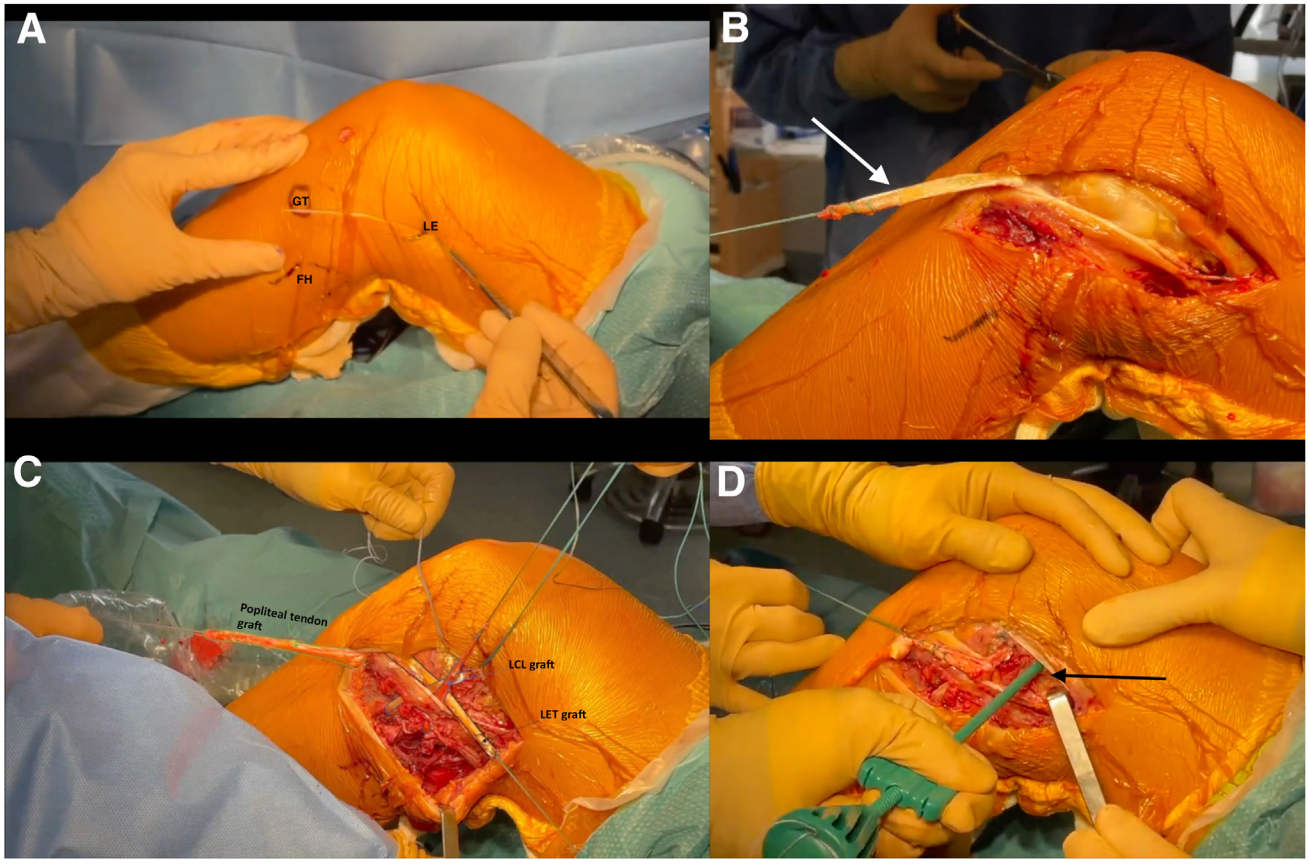


**Fig 6.** Additional posterolateral corner reconstruction and modified Lemaire procedure in right knee: lateral view. (A) Standard exposure extending from Gerdy tubercle (GT) to lateral epicondyle (LE). (B) A 1-cm-wide strip of the iliotibial band (white arrow) is harvested in a standard fashion for the modified Lemaire procedure. (C) The popliteal allograft, lateral collateral ligament (LCL) graft, and lateral extra-articular (LET) graft are illustrated. (D) The iliotibial band graft is fixed to the femur using a suture anchor (black arrow) to limit the risk of tunnel convergence. (FH, fibular head.)

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